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In This Issue . . .

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(EUROPEAN)

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THE KURHAUS-SCHEVENINGEN, HOLLAND

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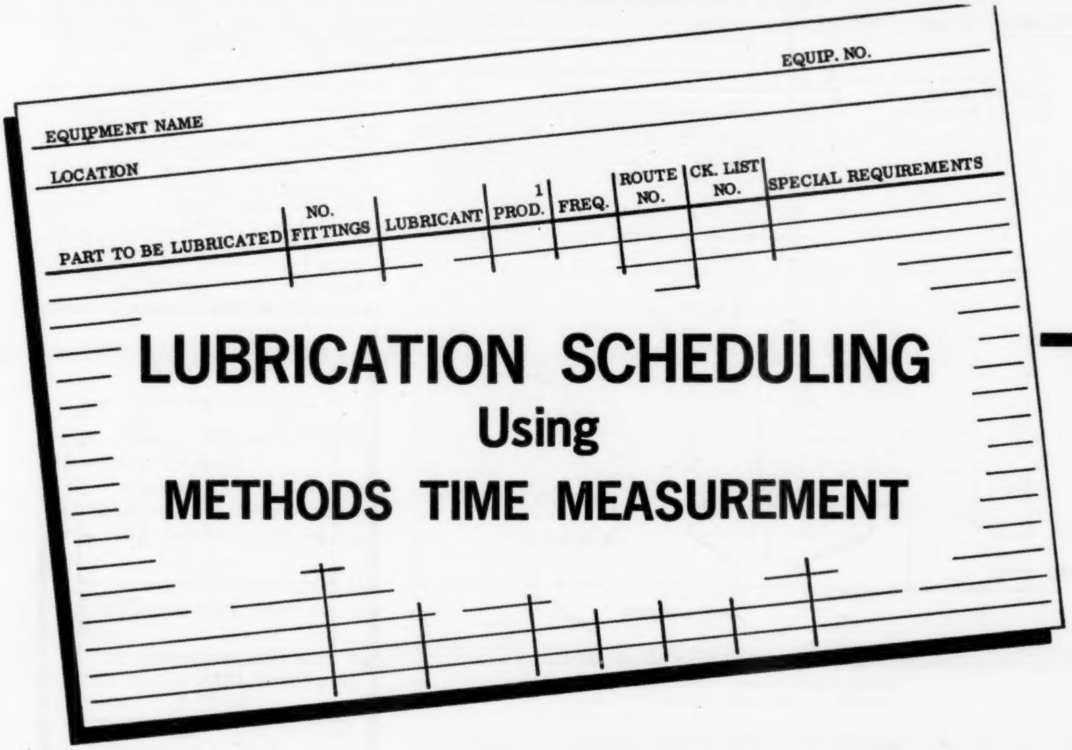


LUBRICATION SCHEDULING Using METHODS TIME MEASUREMENT

By TOM MOSTYN, Executive Staff Maintenance Engineer, Rayonier, Inc.

COST OF INADEQUATE lubrication can be a major drain on company profits. The cost of the lubricants themselves is very small —small when compared to the following:

1. Machine breakdown in which improper lubrication is a factor.

2. Machine slowdown due to worn parts due, in turn, to inadequate lubrication.

3. Machine part replacement cost due in part to insufficient or inappropriate lubrication.

4. Labor cost of applying lubricants.

5. Supervision and overhead costs in connection with the lubrication program.

All this is quite obvious. The trouble is that it is next to impossible to determine the actual costs involved in each of the above items. Even if the mechanics know that faulty lubrication has caused a breakdown they are often reluctant to report the fact and get their oiler "buddy" in trouble. Even if maintenance supervision knows where poor lubrication is responsible for a breakdown, they are not likely to go out of their way to report deficiencies in a function also under their supervision. So the chances are that top management which has "control" over expenditures gets to know of very few cases where "lack of lubrication" costs are excessive.

Machine part replacement costs due to inadequate lubrication are even more illusive. Parts wear out whether they are lubricated or not. The life of a part ideally lubricated and one lubricated under normal practices is seldom compared. Service conditions vary so much that it is impractical to separate replacement costs due to lubrication practices. Anyone close to machine maintenance may know of instances where inadequate lubrication costs have been substantial. But usually no one knows just how much it actually costs the company.

Labor, supervision, and overhead costs normally run four or five times lubrication materials cost. But here again few people have bothered to compare these costs. Relatively few companies compute lubrication costs separate from other maintenance costs. Very few know what "par" for lubrication costs should be even for labor and materials. Very few have made a thorough study of the subject.

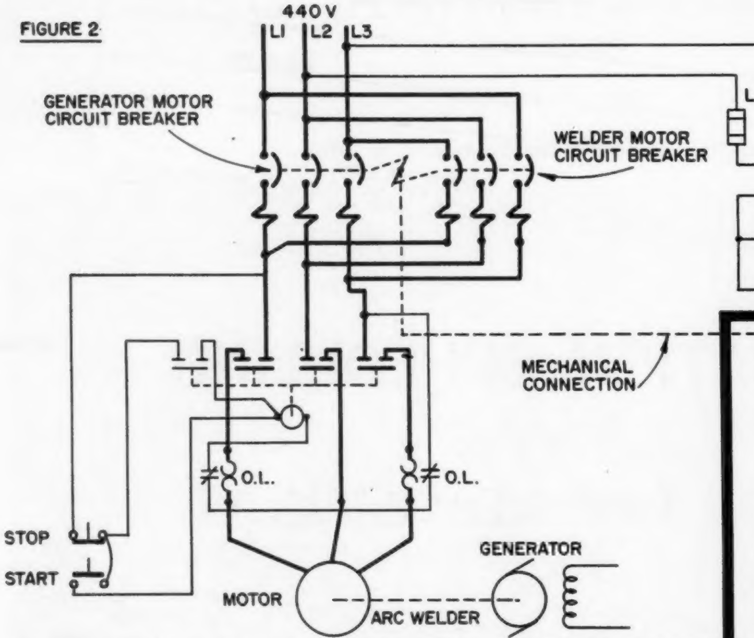
As a start on a lubrication program, the Grays Harbor Division of Rayonier Incorporated made a survey of some thirty oil companies and lubrication equipment manufacturers. No specific programs were recommended by them. We were referred to six different manufacturing companies known to have definite lubrication schedules. These companies were very helpful in their suggestions. But no lubrication program that covered all of the considerations necessary in our application were forthcoming.

What Should Study Cover?

The objectives of a lubrication program should be laid out first:

1. To reduce maintenance costs, including cost of applying lubri-

FIGURE 2



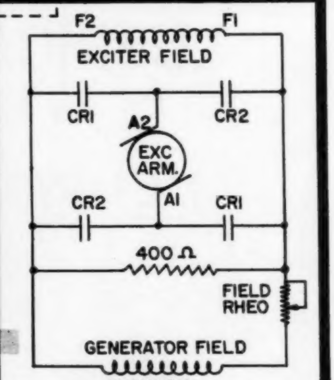


FIGURE 3

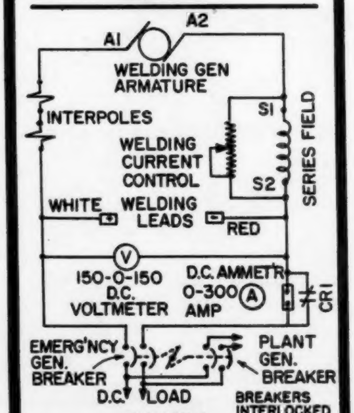


FIGURE 4

tor control circuit is shown in Fig. 2. Rotation is changed from generator to welder by operating the motor circuit breakers. These circuit breakers are mechanically interlocked by the cam shown in Fig. 1. The cam is also key interlocked with the plant d-c supply circuit breaker.

One phase of the load side of the motor breakers is cross-connected to reverse the direction of the driving motor. The mechanical interlock cam has a step milled into the rear of it which operates a limit switch. This cam is designed so that only one breaker can be closed and mechanically holds the other breaker open.

Closing the generator motor breaker energizes the line side of contactor M. Pressing the start button energizes the closing coil of the magnetic starter M and the auxiliary contact holds the starter closed until the stop button is operated.

Field connections are shown in Fig. 3. With the machine running in the direction of rotation of a constant voltage generator, the normally closed side of the limit switch energizes relay CR1. Contact CR1 closes the exciter armature circuit to make A1 - F1 negative and A-2 - F2 positive. The generator field is now energized and the generator builds up. A 400 ohm resistor is connected across F1 and F2 permanently to act as a field discharge resistor.

A schematic drawing of the generator armature circuit is shown in Fig. 4. The welding leads are shown but these are not used when the machine is running as a generator. The unit is permanently connected to the plant d-c bus through the generator load breaker which is mechanically interlocked with the plant generator breaker.

Load current is measured by the 300 amp, 50 mv shunt as the CR1 contact across the shunt is open when the machine is operating as a generator. The d-c voltmeter has a zero center scale to permit reading opposite polarities when switching from generator operation to welding.

When operating as a welder, the welder motor circuit breaker is closed to provide the correct rotation. The limit switch operates CR2 to restore the original exciter armature connections, the generator load breaker is left open and the welding leads connected to the machine.

It is not recommended that this m-g set be paralleled with your plant d-c generator as compounding the two generators would not allow a proportionate division of load between the generators. To prevent this, the generator load circuit breaker is mechanically interlocked with the plant generator breaker.

We found the control cabinet modifications and installations cost about 40 per cent of an equivalent bank of rectifiers and controls. The added bonus of its use as a welder, when needed, overcomes thoughts of its inefficient performance as a voltage generator. **End**

Fig. 1. Form on facing page shows points of lubrication, lubricants to be used, etc. The "Prod." in column 4 refers to production—can the machine be lubricated while it is in production or must it shut down? An "R" is placed in this column if it should be lubricated while running; RN means lubricate running or not; and an N means lubricate only when machine is not running. "Ckl" in column 7 refers to the checklist number. After checklists are completed and numbered the number of the checklist is entered on master lube cards in the equipment records.

cants, stocking lubricants, machine repair and overhaul.

2. To reduce production costs including machine breakdown and mechanical slowdown due to worn parts.

The means of accomplishing this from the lubrication point of view becomes:

1. To define best lubricants and frequencies of lubrication for each machine.

2. To develop best method of lubricating:

a. Best tools—cheapest tools to use in the long run, all costs considered.

b. Best route—involving the least delay to actual application of lubricants.

3. To develop schedules that represent a fair day's work for each oiler.

4. To select and train oilers in using prescribed methods and schedules.

5. To control results through supervision.

It goes without saying that these things should be accomplished without excessive costs of developing the program, and, particularly, without excessive recurring costs in administering the program.

Define the Job

Before you can develop best methods or schedules, you must decide what work must be done—what has to be lubricated and how often. This is no small part of the total job. In a sizable mill, it takes considerable time to find out just what the practices are if they have not been spelled out in definite terms. General instructions and oral orders could become muddled.

Under an informal lubrication "program" it is not unusual to find different oilers using different lubricants and frequencies on the same application. Obviously different practices can't all be the "best way". But determining what is best from the standpoint of minimum machine operating and maintenance cost takes time. Oil companies can help with a survey. But you cannot follow them blindly. Recommendations must be tempered with experience under your particular service conditions. And

FIG. 2. MTM Analysis of Applying Grease Gun to Fitting

MOTION	SYMBOL	TMU
1. Stoop to place oil can on floor, release can	S, R	29.0
2. Arise, gripping wiping rag in motion	AS	31.9
3. Grasp fitting through rag	G1A	2.0
4. Turn rag 180 deg to remove grease	T180S	9.4
5. Flip over rag in motion to head of gun	M20A1	19.2
6. Grasp head of grease gun	G1A	2.0
7. Move head to fitting	M5A1	7.3
8. Position head on fitting (bullneck)	P2SE	16.2
9. Reach for gun handle	R10A	8.7
10. Grasp handle Pump handle to grease[1]	G1A	2.0
11. Reach for head of grease gun	R10A	8.7
12. Grasp head	G1A	2.0
13. Disengage head of gun	D2E	7.5
14. Stoop to get oil can, grasp	S, G1A	29.0
15. Arise	AS	31.9
TOTAL		206.8

[1]Pump handle is a separate allowance of 20 TMU per stroke, the number of strokes estimated from size and fit of bearing.

FIG. 3. Time Allowances for Lubrication

WALKING (count as a step each time balance is shifted, including sidesteps, turning around, stooping, straightening up, etc.)

CONDITION	A—walking on hard surface with oil can and grease gun or pushing cart, or walking down stairs.	20 TMU/ step
CONDITION	B—walking on muddy surface or over cluttered machine parts, climbing stairs.	30 TMU/ step
CONDITION	C—climbing ladders, taking cart up stairs (setting ladder requires average of 5 Condition C steps or 250 TMU)	50 TMU/ step

WORKING

CONDITION	A—easy-to-reach grease fittings, check oil level.	200 TMU/ fitting
CONDITION	B—difficult position of grease fitting, fitting covered with debris.	300 TMU/ fitting
CONDITION	C—oil small chain, fill oil reservoir, fill grease gun at gun filler.	500 TMU/ fitting
CONDITION	D—oil large chain, fill grease gun from open bucket, mark checklist.	2000 TMU/ fitting
CONDITION	E—check gearcase for water, fill air line lubricators with air pressure off line.	3000 TMU/ fitting
CONDITION	F—fill air line lubricators with air pressure on line.	5000 TMU/ fitting

ALLOWANCE PER STROKE OF GREASE GUN 20 TMU

no one oil company has all the best products.

You should be prepared to "engineer" your own program for best results. Furthermore, you should be prepared to alter and improve it as new lubricants are placed on the market. The lubrication program must be flexible to accommodate improvements.

Points of lubrication, lubricants to be used, frequency of application, etc. can be most easily used if the information for each machine is recorded on a separate card, such as the one shown in Fig. 1. Changes on one card do not affect other cards such as would be the case if a list were used. Also, cards can be rearranged in whatever order desired in studying routes, practices with similar machines, machines using the same lubricant, etc. These cards are rightfully a part of Equipment Records and can be filed with the other equipment specifications if the card size is designed for that purpose.

Advantages of Standardization

There are several significant advantages to minimizing the kinds of lubricants used:

1. Lubricant inventories can be reduced.

2. Labor costs of handling many containers and lubricating tools can be minimized.

3. Errors and misapplication of lubricants can be minimized.

4. Chance of lubricant contamination reduced when number of seldom-used containers is reduced.

5. Instructing and training oilers is simplified with fewer products to use.

6. Suppliers are apt to carry larger stocks of lubricants ordered more frequently.

Of course, lubricants should not be misapplied just to standardize. On the other hand, savings from the advantages of minimizing number of kinds of lubricants can often justify the use of a better-than-needed lubricant in some cases. Quite recently several oil companies have placed on the market multipurpose lubricants that can replace most special products. Don't forget, labor costs run three or four times material costs in most lubrication programs.

To develop the best method of doing a job, one must compare the time necessary to accomplish the job with the time of alternate work methods. To determine how long a job should take, and to establish a route that represents a fair day's work for the oilers, you must know the time it takes to do a job. Establishing a realistic time value for lubrication work is the same sort of problem faced in setting production standards. Lubrication tasks are repetitive in the same sense as production work. So we should adopt from production the best time measuring means for our purpose.

What Is MTM?

MTM, or Methods Time Measurement, is a set of established times for the elements of manual work. Much research has gone into developing standard times for typical motions that make up most manual work. By studying a manual task, anyone trained in the application of MTM can outline the motions required. Then by adding the time allowances for the motions, a synthetic time can be developed for performing the task. The time required plus the number of steps to apply a grease gun to a fitting is shown in Fig. 2.

The unit of time used in MTM is one hundred-thousandth of an hour. This unit, called a Time Measurement Unit or TMU, is small and totals of time accumulate into quite a few digits. However, it allows the accuracy necessary for this sort of study, and hours are easily determined by moving the decimal point over five places in TMU totals.

Actually, any reliable method of determining time values for lubrication tasks would be satisfactory so long as the tasks timed are small enough to allow rearranging tasks in different sequences for methods improvements. MTM was used in the Rayonier study because:

1. Building the time standard for different tasks necessitates consideration of motion study. Savings of small increments of time through motion analysis is important when these motions are repeated as often as applying a grease gun to a fitting.

2. Study can be done independent of oilers. Labor is not upset by taking a lot of time studies.

3. Results are consistent regardless of routes developed.

4. Basis of study is objective. Use of published data is often more acceptable than subjective stop watch studies.

Once time values for the various greasing and oiling times have been developed, these times can be added together with times taken up with walking to get times required to cover route. Alternate routes can be developed and these times compared to determine the best route. Time required to cover a route using a cart with needed lubricants can be compared with the time required over the same route with refill stations for hand-carried lubricants. Lengths of routes can be arranged to give the oilers a fair day's work.

Figure 3 is a chart of time allowances for lubricating paper mill type equipment, under conditions found at our mills. The chart is not useful for conditions other than those covered in the particular study. The important point is that such a table can be developed for any lubrication program and its use will lead to a scientific assignment of work that can yield substantial savings.

Finding Best Routes

The routes that grow out of an informal catch-as-catch-can system may not be the least expensive or give the best coverage. At least in the initial stages of the MTM routing it is wise to ignore present practice to give the mind full range in considering all possibilities.

Since labor cost is the most expensive part of even a good lubrication program, routes must involve a minimum of walking time. Isolated areas of the plant are considered first as a route or section of a route to avoid excessive stops by the oiler. If using a cart is impractical because of the equipment layout, routes should be based upon one or two hand-carried lubricants. It is well to start the study in an area most distant from the central "oil house" and work toward the "oil house" so that tag ends of routes can be consolidated.

In any event, methods and route

ROUTE ______ __ EQUIPMENT RUNNING __ NOT RUNNING SHIFT ______ DAY ______ PAGE ____ OF ______

CK. LIST NO.	EQUIP. NO.	EQUIPMENT NAME	PART TO BE LUBRICATED	DESCRIPTION OF WORK LUBRICANTS TO BE CARRIED	NO. FIT.	100 X WRK. CON. [2]	NO. SHOTS	10 X WLK. CON. [3]	NO. STEP	TIME MEASUREMENT UNITS

EQUIP. NUMBER ______ LOCATION OR DEPT. ______

EQUIPMENT DESCRIPTION ______

PART TO BE LUBRICATED	LUBRICANT	FREQUENCY
1.		
2.		
3.		
4.		
5.		

RECORD OF LUBRICATIONS MADE

No.	Date	By	No.	Date	By

Fig. 4. Above: Routes should first be developed by "walking through" and arranging the lubrication equipment record cards in the desired sequence. When the route becomes fairly "firm" list the machine sequence on a route sheet like the one above.

Fig. 5. Right: Lubrication less frequent than one month is listed on a card similar to this and it is placed in a tickler file. When these pop up in the follow-up file it is time to perform this particular lube job.

improvements will become evident throughout the progress of the study so that many alternate routes may be compared on paper. Comparing routes on paper is much more desirable than trying them out with oilers. It is less expensive and much less confusing to the lubrication crew.

Routes should first be roughly developed by "walking through" and arranging the lubrication equipment record cards in the desired sequence. Then when the route becomes fairly "firm" list the machine sequence on the route sheet, Fig. 4. Time values for the entire route can be filled in after counting steps required to walk route.

Totals of TMUs for each lubrication are placed in the next to the last column on the right. Subtotals of lubrication times are entered in extreme right hand column. These subtotals will keep the analyst aware of the elapsed time in each route throughout the study of each route. Subtotals of grease shots will indicate approximately when grease guns must be refilled—where lubrication supplies should be located.

Little difficulty will be experienced in the oiler meeting the time allowances and covering the prescribed routes so long as all necessary lubrications are covered in the study. This is a simple direct study, but it does involve a multitude of machines and lubrication points. Therefore, it is necessary to run a continual check to avoid errors.

To start with, make sure all equipment requiring lubrication is included in the lubrication equipment record cards. This can be done easily in most plants by using existing equipment lists and then checking the cards in a physical sweep of the plant. From then on in the study, each step is keyed to the appropriate lubrication equipment record card. A review of these cards at the end of the study will show up any time or machines left out. In this way, errors can be controlled and minimized.

Definite and explicit instructions should be given oilers. Yet administration costs should be kept to a minimum. Two different types of lubrications normally exist from the administrative point of view:

1. Routine lubrication—frequent lubrication with routing, methods, tools, planned in detail.

2. Periodic lubrication — infre-

LUBRICATION ROUTE SCHEDULE

ROUTE Wood Mill DAY Tuesday

6:00 AM	Pick up weekly lubrications (not running) along daily (not running) route.	
		1140—20' Barker carriage—top side.
	DAILY ROUTE	1140—20' Barker—Gear cases for daily route equipment.
		1774-1775—Wet conveyors under barker, gear reducers.
		1711—Log haul from cutoff saw, gear reducer.
		1710-1708—Roll cases at cutoff saw.
		1706-1707—Log hauls.
		1713—Roll case at 20' barker, reduction gear.
		1757—Log haul to 8' barker, reduction gear.
		1762—8' Log storage deck, reduction gear.
7:00 AM	DAILY ROUTE	1240—8' Hydraulic barker, nozzle trunnions.
		—8' Hydraulic barker, top side, swing joints, solenoid valve.
		1240—8' Hydraulic barker, top side carriage.
		1176—Cant offbearing table.
		1729—Cant transfer from band mill, head pulley.
8:00 AM	DAILY ROUTE	1728—Band mill roll case.
		1172—Band mill.
		1718—Chip conveyor under 153" chipper.
	By 153" chipper, up steps, along south side of 2nd floor.	
		1717-1716—Roll cases, roller chains.
	Out south door, around 20' barker, down log hauls.	
		1328—Bundle deck crane—Wheel bearings.
		—Drive
		—Brake
		—Cable returns
		—Hoist
		—Lower block
9:00 AM	To north end 2nd floor bundle deck.	
		1216—Slasher, roller chain.
		1757—8' Log haul to hydraulic barker.
	Up north walkway by 20' log hauls.	
		1709—East roll case at cutoff saw—roller chains.
		1713—Roll case at 20' barker—roller chains.
	Around end of 8' hydraulic barker.	
		1757—Log haul to 8' hydraulic barker.
		1722—East log and cant roll case—roller chains.
10:00 AM		LUNCH TIME
10:30 AM	Second floor wood mill—northeast corner and down band saw line.	
		1762—8' Log storage deck—roller chains.
		1759—Transfer to 8' hydraulic barker.
		1729—Cant transfer from band mill.
		1723—Center and cant log roll case.
	Out northwest corner of second floor wood mill.	
		1792—Chip screens over conveyor to refuse-roller chain.
		1365—Canting gear over 110" chipper.
	DAILY ROUTE	(Equipment Running) Ditto Monday.
11:30 AM		
12:00 N	DAILY ROUTE	Drum barker.
12:30 PM	Clean oil storage areas, get supplies, perform monthly and periodic lubrication.	

quent lubrication; fill-in work to regular routines and/or working foremen.

Checklists are a natural means of assigning highly repetitive routine lubrications at low administration cost. Once a checklist is made up, it merely has to be reissued regularly. There is no searching of equipment records or other files and listing lubrications for the day.

The checklist also "locks in" the best route and schedule developed as part of the methods study. It makes it easy for the oiler to stick to the desired routes. He merely follows the numbered sequence of checklists posted in the mill.

Checklists cannot give all the instructions necessary. A description of work methods in a maintenance manual can do that. However, the checklists do act as a reminder and keep lubrication from drifting into poor practices.

Lubrication checklists marked by oilers also tell supervision what is being lubricated—and what is more important, what is not being lubricated. This record does not do away with the need for direct supervision. However, it does make supervision easier and facilitates on-the-job training of oilers.

The labor cost of oilers marking checklists is insignificant when compared with the positive savings this practice can insure. At Rayonier, actual time taken to mark checklists amounts to approximately 6 per cent of oilers' time on the job. Walking time on the other hand consumes almost 60 per cent of some oilers' time. It is easy to see that it takes very little reduction in walking time to pay for the use of checklists. If the use of checklists sequenced in the shortest route can help avoid use of alternate longer routes, the time required to mark checklists is well spent.

Furthermore, the checklist facilitates the following of improved methods developed in the over-all

Fig. 6. A daily lubrication route schedule such as the one shown on the facing page helps to spot inequities or possible improvement in routes. It also helps supervisors understand routes and lets them know where oilers can be found at any time during the day.

study. Checklists are the teeth in the gears of the lubrication program. In the first route developed at Grays Harbor Division of Rayonier, labor savings of 43 per cent were realized and, in addition, lubrication practices improved. The use of checklists will help perpetuate these savings and act as a base for further improvements.

Checklists are not the answer for seldom-repeated lubrications or periodic lubrication. The long cycle makes the checklists too lengthy and cumbersome to use. Any lubrication less frequent than once a month is listed in a tickler file at Rayonier. Cards similar to Fig. 5 are filed under the month the next lubrication is due for each machine. The lubrication leadman maintains the file and assigns work from it as fill-in-work to the regular schedules.

As a lubrication is completed, he fills in the date of the lubrication, type of lubrication made and files the card under the next month that lubrication is due. He makes sure all cards are out of the current month file by the end of the month. Then he shifts the month divider to the back of the file ready to receive cards due that month on the following year.

In this way, he always has just the cards showing need of equipment lubrication for a particular month. No need for reviewing all periodic lubrications to pick out the assignments for one month. Supervision can review cards to determine how completely each piece of equipment is being serviced.

At Rayonier, six hours of routine lubrication were scheduled for each day. The other two hours were allowed for unavoidable delays (plugged fittings, production calls), personal time, replacing supplies, cleaning lubricating equipment, periodic lubrication assignments. The ratio of periodic lubrication time to routine lubrication time pretty much determines the number of hours each day you can schedule routine work. A rough comparison of the TMUs involved in periodic and routine lubrication will usually suffice in setting a "cut-off point" in daily routine schedules.

As routes are built and times accumulate, an over-all picture of crew requirements will emerge. Basically, the number of routes will determine the number of men required in the crew. At this point in the study, thought must be given to possible shift schedules which may be made necessary by production schedules, premium pay hours scheduled, oilers' days off, etc. Individual routes should be balanced. Equal amounts of scheduled work should be assigned to all oilers if possible.

A daily lubrication route schedule shown in Fig. 6 helps to spot inequities or possible improvements in routes. It also helps supervisors understand routes—gives them a schedule of where oilers are likely to be found any time of day.

Checklists should be made only after all routes have been accepted as the best method and schedule of lubrication. Then, start with the Monday route and fill out the checklists keeping in mind the best positions for the lists in the plant. Ozalid or other black line producing process provides a print that will stand up for the month that posting is required. In any case, originals should be easy to change so that there is no deterrent to keeping checklists current.

Periodic lubrications can be entered on tickler cards after checklists are completed. Then, the supervisor of the lubrication crew should place the cards in the file for the next month he plans to perform each periodic lubrication. An effort to spread out the periodic lubrications among all months will insure an even loading of the lubrication crew in this type of work.

Accompany Oilers on Route

After a "how, why, when, where, who" discussion with the people involved, checklists should be mounted in the plant. It takes less time to mark mounted sheets, is less cumbersome for the oiler, and is less likely to cause mixed-up or lost sheets. Permanent mounting of checklists also facilitates close supervision—stimulates interest in lubrication on the part of production foremen. When approached properly, oilers will not resent the change, particularly if improved methods make their job easier and if an opportunity for advancement is given to displaced oilers.

Whoever developed the route sheets should accompany oilers on their first rounds of the new routes. It may be difficult to complete routes at first because of delays involved in becoming familiar with them. Usually, oilers can keep on the schedule after the second or third week.

Throughout a detailed study such as this, it is important to keep in mind the intent of the program:

1. Minimize equipment failures due to faulty lubrication.

2. Facilitate effective supervision and training of oiling crews.

3. Reduce lubricant inventories.

4. Minimize lubrication crew size.

5. Provide basis for future lubrication improvements.

It is easy to get so involved in details that the real objective is lost. Revisions for improvement should be reflected in all steps of the procedure as soon as they are adopted. Checklists should specify current desired practices. Oral revisions to checklists should be avoided or they may become meaningless.

The procedure for improving lubrication practices and reducing lubrication man-hours is useless unless followed. It is not enough to merely "engineer" the job. It must be sold to all concerned and in time adopted by supervision as its own. Once foremen and their men understand the reasons for the program and the way it is supposed to work, they can be expected to go along with it on a trial basis. Only experience with it will lead to active support. The system is just the tool; people must actually produce results and make benefits into profits. **End**

APPLICATION I

MTM VERSUS TIME STUDY FOR FORMULA CONSTRUCTION

by
Klaus H. Nincke
H. B. Maynard and Company

Methods-Time Measurement[1] (MTM) is a tool of methods analysis which gives the actual relationship between basic motions and the time required to make them. It is based on the following premises:

1. Any manual operation is made up of distinct and recognizable basic motions.
2. Each basic motion has a constant time value at the average performance level.
3. Research has measured the time values for all basic motions. These time values are the MTM data.

Any technique that is used to develop standards can also be used to develop time formulas. However, the question is whether the technique is as good as, better, or on a par with existing techniques used to develop formulas. To get an answer as to how well MTM was adapted to formula construction, it was compared with the existing time study procedure[2] for constructing time formulas.

The comparison revealed that MTM had distinct advantages over usual time study procedures. The advantages attained can be broadly grouped into four different areas:

A. Speed in the development of the formula.
B. Greater coverage.
C. Ease of revision.
D. Greater accuracy.

Let's examine each of the four advantages in more detail.

A. Speed in the Development of the Formula

Industrial Engineers using MTM have reported that the time required to construct a formula has been reduced as high as 70% over time study methods.

To establish why this is possible, let us compare the procedures used in each system. Figure #1 shows the general procedures used in chronological order.

By referring to Figure #1, it can be readily seen that the basic procedures followed in each system are very similar. However, there

FIGURE #1

Time Study Procedure	MTM Procedure
1. Survey work to determine the field to which the formula will apply.	1. Survey work to determine the field to which the formula will apply.
2. Survey the field to establish if the equipment, work layout, methods, etc., are satisfactory.	2. Survey the field to establish if the equipment, work layout, methods, etc., are satisfactory.
3. Divide work into standard elements required to manufacture the parts the formula is to cover.	3. Divide work into standard elements required to manufacture the parts the formula is to cover.
4. Take time studies that will provide sufficient data to enable the engineer to establish representative times for the elements determined in Step #3.	4. Make MTM observations of the operations to obtain the motion patterns for the elements determined in Step #3.
5. Transcribe data in Master Table of Details.	5. No analogy.
6. Classify operations.	6. Classify operations.
7. Select representative time values or determine averages for elements listed on Master Table of Details.	7. No analogy.
8. Construct table or curves for variable elements.	8. Construct tables for variable elements by combining the proper motion patterns.
9. Synthesize the constants and tables to be used in the formula expression.	9. Synthesize the constants and tables to be used in the formula expression.
10. Develop the "Setup" and "Each Piece" algebraic expressions.	10. Develop the "Setup" and "Each Piece" algebraic expressions.
11. Prepare the "Table of Detail Operations."	11. Prepare a summary sheet of elemental operations and their respective time values.
12. Prepare the balance of the formula report.	12. Same except there is no list of time studies.

1. "Methods-Time Measurement" by Maynard, Stegemerten, and Schwab.
2. Time Study procedures are those detailed in "Time and Motion Study" by Lowry, Maynard, and Stegemerten.

are three steps in the procedure that are decidedly different, and it is in these that MTM gains its advantage over time study.

Step #4, the taking of many time studies, is not only a time-consuming task but may spread over a period of many months due to the difficulty in obtaining studies representative of the field to which the formula is to apply. It is true that studies taken in past years may be applicable in the construction of a formula. However, it has been my experience that these "old" studies usually are not suitable due to improper breakdown of elements, obsolete methods, and insufficient information concerning the conditions existing at the time of the study. Therefore, these studies are usually discarded and a completely new group of studies has to be taken. In short, it will take considerable time using time study to collect the data required to construct a formula.

This time can be reduced 65%, on the average, by the application of MTM. In the application of MTM, it is only necessary to obtain the motion patterns for the standard elements determined in Step #3 of the procedure (Figure #1). To obtain these motion patterns, observations of the operation are made, and the average motion patterns which apply to the element are recorded. It is not necessary to study the complete cycle of even one piece, let alone the many cycles required in time study. Observations of this type are made until the motion patterns for all the desired elements are recorded.

It should be stated at this point that motion patterns may be taken from MTM studies previously taken. This is possible with MTM, since we are dealing with a sequence of motion patterns whose chronological order will remain unchanged regardless of element description. In other words, the motion pattern for a desired element may be just a segment of a motion pattern of an element from a previous study.

The standard time for each element is derived by recording the predetermined standard time for each motion and adding the motion times recorded for the element.

This brings us to steps #5 and #7 of Figure #1. Step #5 refers to the transcribing of data to the Master Table of Details, and step #7 refers to analyzing the data recorded on the Master Table. These two steps are not required when MTM is used. As a result, the time required to prepare and analyze the master Table is eliminated.

Variations in process cycle times, scope of the formula, skill and experience of the engineer constructing the formula all affect, in the final analysis, the time required to construct a formula. Over-all cycle times, of course, do not affect the time required to make an MTM formula since no complete studies are required. Savings in time achieved by using MTM for formula construction are variable, but reductions in time from 15% to 70% have been experienced. In addition to the direct savings, the fact that formulas are ready for use in a much shorter calendar period is of considerable benefit. With MTM, no delays are encountered waiting for the opportunity to take time studies to obtain data for a specific situation.

In order to illustrate the savings that are being achieved by using MTM, Table I on the following page, was constructed. The formulas referred to in Table I were used to set standards on medium-sized parts, and time values set from the formulas ranged from .0025 decimal hours to several hours. Table I shows that an average savings in time of 66% is achieved in just collecting the data required to construct a formula. This does not take into account the time required to construct and analyze the Master Table of Detail Time Studies in order to select the standard times. To state the savings in another way, "Data for approximately three formulas can be collected using MTM in the time formerly required to collect data for one formula."

Table I also shows a comparison of the number of elements required. It is natural that more elements are required with MTM, since the elemental times are less. However, the MTM elements have much greater application, not only to one formula, but most applications are used in other formulas developed in the plant. The recent developments of Universal Maintenance Standards and Unified Standard Data are examples of how MTM elements are universally applicable.

B. <u>Greater Coverage</u>

The advantage of formulas for setting standard times is the ability to be able to set the times for a variety of work quickly and accurately. It is apparent, then, that a formula that will provide the necessary information to set standards for a great variety of work is of more value than that limited to a narrow range. Such a formula not only reduces the number of formulas required, but also reduces the number of individual studies required as a result of incomplete coverage.

APPLICATION I

TABLE I

COMPARISON OF TIME TO COLLECT DATA FOR TIME FORMULA DEVELOPMENT

	TIME STUDY METHOD			MTM METHOD	
Formula Type	Number Studies	Time Required to Take Studies @ 4 hours/study	Number Elements	Number Elements	Time Required to Develop Motion Patterns*
Hack Saw Cutoff	6	24.0 hours	21	31	10.00 hours
Engine Lathe	30	120.0 hours	129	143	46.00 hours
Punch Press	4	16.0 hours	51	70	22.5 hours
Drill Press Spindle	3	32.0 hours	40	71	22.5 hours
Radial Drill Press	51	204.0 hours	102	111	35.0 hours
Turret Lathe	32	128.0 hours	114	102	32.0 hours
Milling	47	188.0 hours	149	211	68.0 hours
TOTALS		712.0	606	739	236.0

$$\frac{712.0 - 236.0}{712.0} = 66\% \text{ Savings}$$

$$\frac{739 - 606}{606} = 22\% \text{ More elements required when MTM is used.}$$

*Based on 25 Patterns/8 hours.

MTM provides a means of increasing coverage by:

1. expanding the scope of formulas within a given operation.

2. expanding the formula technique of setting standard times to operations previously considered impractical.

That this is possible with MTM is a result of being able to synthesize the elemental times by visualization or simulation of the motions required for unobserved operations. Besides this feature, the ability to divide the elements into very short increments of time makes it possible to apply the elements to a much broader base of operations. The above two features of MTM together with eliminating the necessity for taking complete cycle times studies make it economical and practical to develop time formulas to cover many additional operations.

C. Ease of Revision

When methods improvements are introduced, time standards should be revised to reflect the savings achieved by the method improvement. When MTM is used, there are three important advantages which are not possible with time study. They are:

1. Methods improvements developed in the course of constructing the formula can be incorporated into the formula without any delays.

2. Revisions required after a formula has been completed can be made quickly and easily.

3. Minor improvements can be easily evaluated and incorporated into the formula.

The importance of these three advantages cannot be over-emphasized.

It is a common experience that during the construction of formulas, methods improvements are encountered that are justified.

When the time study procedure is used, it is next to impossible to evaluate accurately the effect of the improvement with standards unless the improvement is installed and a time study taken. The installation of the method improvement may be costly and time-consuming and as a result, considerable delay may be encountered. Therefore, many times the formula is constructed using the old method, knowing that a revision will be required. Then, to make the revision at a later date necessitates the taking of additional studies, in addition to all the other necessary

calculations and clerical duties required in formula construction. The cost of these revisions is at times equal to the cost of the original formula. On the other hand, if the formula is to include the revised method, then the completion date of the formula will be delayed in direct proportion to the time required to install the method improvement, instruct the operators in the new method, and wait for the operator to become proficient in the new method before the time study can be taken. Production losses due to these delays in shops having no standards or incorrect standards are difficult to evaluate, but are certainly worth considering.

When the MTM procedure is used, an experienced MTM practitioner can visualize the motions required for the new method, and in this way incorporate the standard times in the formula for the new method.

MTM provides, then, the means of not only reducing the possibilities for formula revisions, but reduces considerably the delays formerly experienced when methods improvements were introduced in the course of constructing a formula.

There are innumerable occasions when methods improvements are introduced after a formula has been in use. To revise these formulas using the time study procedure means taking additional studies and repeating the same procedure as followed in making the original formula. In many instances, these revisions take almost as much time as the original formula.

When MTM is used, it is only necessary to revise the motion patterns affected by the method improvement or to develop new patterns, whichever is the most logical. It is then only a routine procedure to change the charts and constants that are affected by the method change.

The revision of formulas that have been in use brings us to another important advantage of MTM. That is the ability to reflect minor methods improvements. These improvements were formerly impractical to measure with a stop watch, and as a result were not reflected in the standards. The accumulation of these minor methods improvements over a period of years resulted in many loose standards. The difficulties encountered by companies attempting to rationalize these loose standards are well known. These minor improvements can be accurately evaluated by MTM and the formulas updated which virtually eliminates any reason for standards to become loose as a result of the accumulation of minor methods improvements.

The benefits derived by being able to revise formulas easily and quickly are:

1. Economic.

2. Improved human relations.

3. The industrial engineer has more time for cost reduction work.

D. <u>Greater Accuracy</u>

Accuracy is of the utmost importance in formulas due to the vast number of standards that will be set from the formula. Therefore, any procedure that can eliminate areas in which inaccuracies can occur is important. The MTM procedure does eliminate areas in which inaccuracies can occur when time study is used. These areas are:

1. Time studies are not required, thereby eliminating the possibilities of errors:

   a. in the leveling procedure,
   b. from studying inexperienced operator,
   c. from minor variation in material, work place layout, operator attitude, and so forth.

2. The reluctance to take sufficient number of studies to obtain representative standard times for the elements.

3. Lack of judgment in selecting representative standards on the Master Table of Details.

4. Minor variations in the break points of elements from study to study.

Additional areas can be enumerated, but those mentioned should suffice to point out that inaccuracies are possible using time study that are not possible using MTM.

CONCLUSION

MTM has not only proven to be adaptable to formula construction, but is much more economical and versatile than the time study procedure. The benefits are again:

A. A time reduction of up to 70% in the construction of a formula.

B. Calendar time for formula construction is reduced considerably.

C. Formulas constructed generally cover a greater range of work.

D. Revisions are more easily made.

E. Greater accuracy is obtained.

These benefits are well worth considering by any company contemplating a program of developing or revising standard time formulas.

APPLICATION II

A TIME FORMULA SOLUTION FOR AIR FORCE REWAREHOUSING STANDARDS

by

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Hill AFB, Utah is the home of the Ogden Air Materiel Area. A logistic support complex that serves seven western states and has world-wide control over many prime weapons systems. Within the organization of OOAMA, as the Ogden Air Materiel Area is known, are five directorates which the Directorate of Supply and Services, is one, employing some 2,200 people. The Supply Directorate's mission is to provide supplies and logistical services to Air Force units throughout OOAMA and in certain prime classes throughout the world.

In performing this mission, about 600,000 different items are stored in warehouses and an activity of 11,653 items per day are debited or credited. These items amount to 1403 tons of material that are moved in and out of the warehouses during a normal daily operation.

There are many items, however, whose activity changes from time to time, and often it is more advantageous to move items to or from towveyors, apron conveyors, or other restricted mechanized conveyances so that all active items are in the proximity of mechanized equipment. It is this movement of items to another warehouse or within the same warehouse that we term rewarehousing.

The regular handling of material whose movement is caused by a normal receipt or shipment is covered by engineered labor standards, and the results of labor activity in receiving or shipping items is reported on an "earned hour report," which shows the labor utilization in the particular work center. To date, there has been no satisfactory standard set on rewarehousing—the reason for this being the non-standard materials handling practices used in moving the material to a new warehouse location.

In order to allow "earned hour credit" for performing the rewarehousing workload, a system had to be designed, not only to account for the work content of the job, but to count the elements of work as it is performed, so it could be reported in a mechanized reporting system shortly after the work was performed. Of course, the cost of performing the accounting function had to be within the bounds of normal economy.

Past time study experience showed our methods and standards staff that average times or modal times to rewarehouse a location did not represent accurately the earned hours in rewarehousing function for a two-week report period.

At the annual Industrial Engineering Seminar sponsored by the Salt Lake Chapter of AIIE, a lecture on Universal Maintenance Standards was given by Dr. H. B. Maynard. The authors attended that session and decided to apply Dr. Maynard's principle to the rewarehousing problem. Since rewarehousing is a non-repetitive type function, we used Dr. Maynard's theories and developed a "work-order" type rewarehousing standard based on MTM standards and our own standard data.

The system briefly works like this: When a major rewarehousing project is conceived, a work order is established and a time study analyst is called to look at the job. Using a set of predetermined time formulas, the Analyst tailors an engineered standard to match the best method of moving the property as determined by the storage specialists. As the property is moved to the new location, an AF Form 227 "Change Location Card" is accomplished for each commodity being transferred. (The total job time is divided by the number of line items (stock items) to assign a pro-rated time value to each Form 227 "Change Location" that is turned in to the Production Control Office. Production Control then credits the warehouse with earned hours as they receive the Form 227s.)

The necessity of setting a rewarehousing standard grew from the fact that about half a milion dollars per year is spent in rewarehousing property to allow for greater savings in materials handling of items that have a greater turnover. An accurate measure of effectiveness leads the Storage supervisors to problem areas

and methods improvements. In justifying manpower the standards are invaluable where reductions in force tend to be made indiscriminantly. In addition, manpower planning of rewarehousing projects can be made more scientifically by using the formulas.

The standards were broken into three different categories, for bulk, box pallet, and bin stock material. We designed a standard for moving property from one warehouse to another, and within each warehouse and for each of the above categories a standard for removal from the location and storing the property. In essence nine standards have been established and are available for use when the variables are plugged into the time formula. The formula represents an approved method of moving stock in the warehouse, however warehousemen may vary technique if conditions permit further economy steps.

As a matter of example let us examine, in detail, the standard established to cover the rewarehousing of bin stock items from the losing location to the door.

Bin stock is warehoused with a stock item (one AF stock number) in each bin location. Normally, when moving, the material is removed from the bin and to prevent loss is placed in sacks or larger boxes depending on the material configuration. Generally two sacks are filled, that is, two locations are emptied before the warehouseman carries the two bags or boxes to a flat pallet or "egg crate" that has been set at the end of the bin row. This is repeated until all the bin locations are emptied. An extensive sampling study shows that the material from twenty locations can be stacked on one flat pallet or "egg crate." As the pallets are loaded, a fork lift truck carries the material to the new locations or to a flat-bed truck depending on the new location and an AMC Form 227, "Kill Location," is prepared and sent to the locator office.

When the material arrives at the new location it is loaded out by fork lift and carried to the end of the bin row where a warehouseman carries it to the new bin location two bags at a time.

STUDY #1 - Pull bag or box filled with property (one location, one line item). See Study #1 - Appendix. This standard, .040 minutes per carton pulled from the shelf and placed in the collecting box. The dependent variable here is the number of items N* removed from the shelf.

STUDY #2 - Place carton or items in bag or collecting box. The time .075 minutes per piece is the sum of all times for removing one unit from the shelf. The variable is N, the number of boxes pulled. See Study #2 in Appendix.

STUDY #3 - Carry item to pallet. The warehouseman carries the property from two bin locations to the flat pallet. We call the total property in one big location a line item. In this case 15 steps at 17 TMU per step x 2 for return trip = .177 minutes per line item. The LI (stock item) acts as the variable in our time formula.

STUDY #4 - Carry pallet and load to truck and load. See Study #4. Travel is calculated from fork lift standard data. The time to run a fork lift is .0023 min. per foot traveled f_t. The total standard is then .5792 + travel + .209 obtain lift or .209 + .5792 + .0023 (f_t) where f_t is the distance to the loading dock.

STUDY #5 - Obtain flat or safety pallet. .2758 + travel or .2758 + (.0023) f_p where f_p is the distance between the end of the bin row and where the pallets are stacked.

STUDY #6 and #7 - Prepare AF Form 227. Part of the form is prepared in the warehouse, the other is prepared in the warehouse locator office.

<u>Source</u>

Time study	.739	- Kill location in warehouse
Time study	.481	- Locator work
	1.220	

In rewarehousing an AF Form 227 is accomplished for each line item rewarehoused. The variable in the time formula is LI.

The development of the time formula to accomplish a bin rewarehousing job is as follows:

#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
Time to Pull Bag or Box Full of Property (1 Location)	Place in Bag or Box	Carry Item to Pallet	Carry Pallet to Truck	Obtain Flat or Safety Pallet	Prepare Kill Location 227 Whse	Prepare Kill Location 227 Whse	Make Up Carton	Check Stock Number	Prepare Part Tag 50B
.040	.075	.177	.5792+ travel	.2758+ travel	.739	.481	.522	.021	.845

*Sample 1/2 of bin locations, count number of units in each bin, use average number of units per bin times line items to be pulled as N for the job.

APPLICATION II

STUDY #8 - Make up cartons. MTM Study #8. This depends upon the number of line items or bin locations that are emptied. Cartons sometimes (1/2 of the time) have to be made up to receive bin stock. LI is again the variable applied to this time.

STUDY #9 - Check stock number. This time allows for checking accuracy of stock number on material to be moved. The variable is each line item. See MTM Study #12.

STUDY #10 - A part tag is prepared for each LI and is sent with the material to the gaining warehouse. To complete the rewarehousing job, all of the ten jobs must be accomplished. Then the standard or allowance for doing the job should be the summation of the elemental times. (The following table will lead to the development of the time formula:)

TASK	TIME	VARIABLE
1. Pull property	.040	N
2. Place in bag or box	.075	N
3. Carry to Pallet	.177	LI
4. Carry to truck and load, return to bin	.5792 + travel	f_t
5. Obtain Safety or Box Pallet, return to bin	.2758 + travel	f_p
6. Prepare paperwork "Kill Location" in Locator Office	.481	LI
7. Prepare paperwork "Kill Location" in Warehouse	.739	LI
8. Make up cartons	.522	LI
9. Check Stock Number	.021	LI
10. Prepare Part Tag 50B	.845	LI
11. Obtain fork lift	.209	-

The occurrence factors of the elements have been developed from the extensive statistical sampling of 4,000 historical rewarehousing projects.

ELEMENT NUMBER	OCCURRENCE FACTOR AND DESCRIPTION
1. Pull item	This occurs once for each item pulled from the shelf.
2. Bag or box material	This occurs once for each item pulled from the shelf.
3. Carry to pallet	Studies show that a warehouseman carries 2 line items at a time to the pallet placed at end of bin row.
4. Carry pallet to truck	An average of 20 line items of bin stock are required to fill one 4'x4' pallet or "egg crate."
5. Obtain flat or safety pallet	A flat pallet or "egg crate" is obtained for each 20 line items picked from the shelf.
6. and 7. Prepare paperwork	A "Kill Location" is performed for each line item rewarehoused.
8. Make cartons	Samples show that a carton is made once for every two line items.
9. Check stock number	Once for every line item.
10. Prepare Form 50B and attach	Once for every line item.
11. Obtain fork lift	Once for every line item.

The time formula is then:

$$T_j = N(.040) + N(.075) + (2).177\frac{LI}{2} + .209$$

$$(.5792 + (.0023)\, f_t(2)\frac{LI}{20} + (.2758 + (.0023)\, f_p(2))\frac{LI}{20}$$

$$+ (.739)\, LI + (.481)\, LI + (1/2)(.522)\, LI + .021\, LI$$

$$+ .895\, (LI)$$

which simplifies to:

$$T_j = .209 + .115N + 2.524\, LI$$

$$+ (.8550 + .0046)(f_t + f_p)\frac{LI}{20}\,.$$

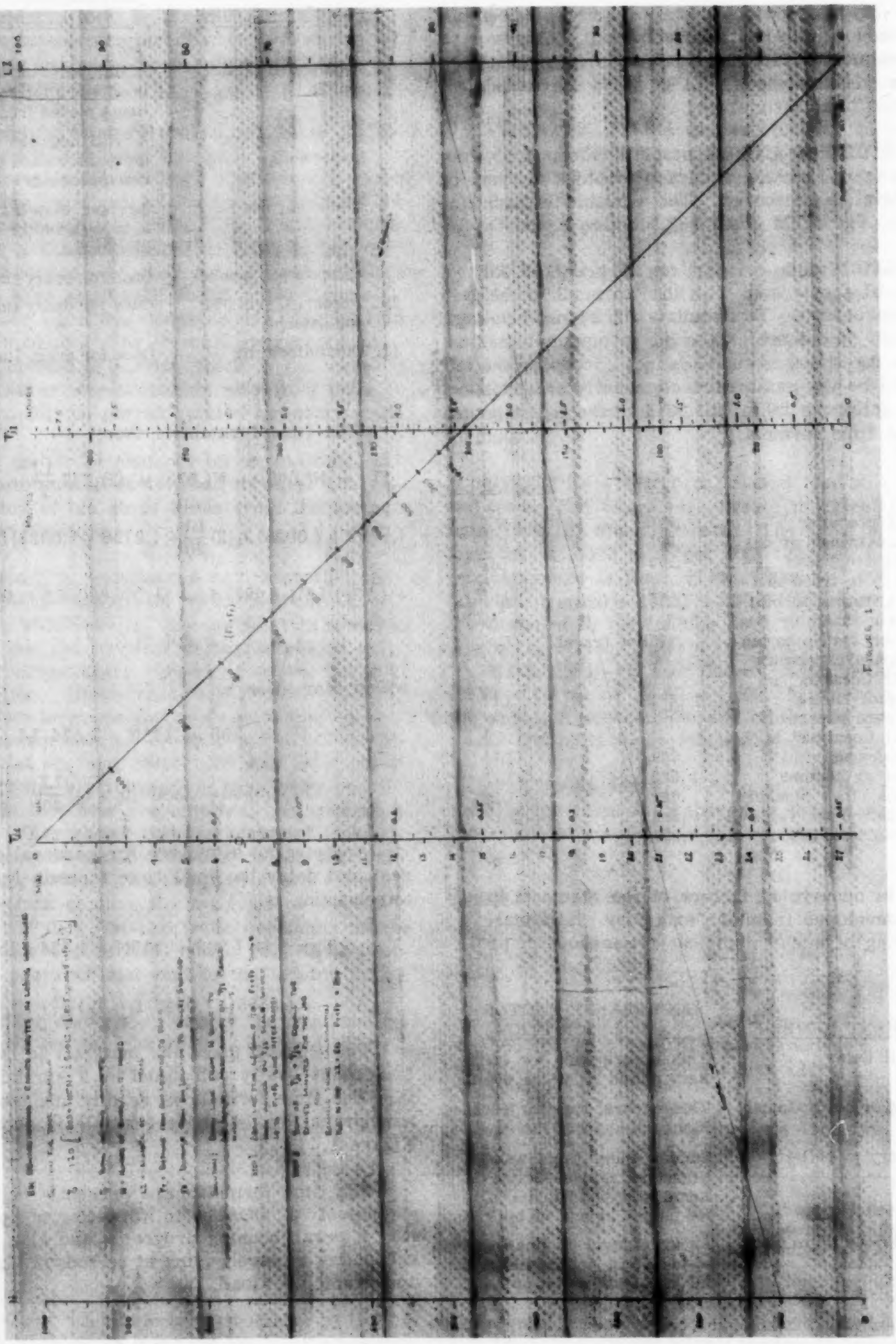
Applying an allowance for personal time, rest and delay the final time formula for bin rewarehousing is:

$$T_j = 1.20\, (.209 + .115N + 2.524\, LI$$

$$+ (.8550 + (.0046)\, f_t + f_p)\frac{LI}{20})\,.$$

The time to place the material in the new location is easily calculated by a similar formula. The time formula is readily adaptable to a nomograph for the above example is shown as Figure 1.

The time formulas are presently being used extensively at OOAMA in allocating manpower to major rewarehousing programs and also for scheduling rewarehousing at periods of slack debit and credit workload.



MTM ELEMENT ANALYSIS

File

Part Name | Part No.
Oper. Name Place material in bag (paper) | Oper. No.
Operator | No. | Analyst T/Sgt. Cave | Date 23 Oct 59

DESCRIPTION - LEFT HAND	F	MOTION	TMU	MOTION	F	DESCRIPTION - RIGHT HAND
Reach for paper bag		R16B	15.8			
Grasp		G1B	3.5			
Move bag towards body		M12B	13.5			
Regrasp to hold		~~G2~~				
Move bag upward and downward to flip open		M24B	20.6			
Regrasp after stop		G2	5.6			
Move bag upward to hold		M12B	13.4			
			15.8	R16B		Reach for material
			2.0	G1A		Grasp
			15.8	M16B		Move material into bag
				~~G2~~		Regrasp to hold
			2.0	RL1		Release
Move bag aside		M16B	15.8			
Release		RL1	2.0			

No.	Element Description	Element Time TMU	.0006 Lev. T.	% Allow-ance	Element Time Allowed	Occur-rences per piece or Cycle	Total Time Allowed
1.	Reach for bag and open	72.3	.043				
2.	Place material in bag	35.6	.021				
3.	Bag aside	17.8	.011				
						TOTAL	.015

MTM ELEMENT ANALYSIS

File

Part Name | Part No.
Oper. Name Pull item from Bin Location m | Oper. No.
Operator | No. | Analyst T/Sgt. Cave | Date 18 Dec 58

DESCRIPTION - LEFT HAND	F	MOTION	TMU	MOTION	F	DESCRIPTION - RIGHT HAND
Walk to bin location from office area		W25P	375.0			
Check location on document while walking to location		~~R~~				
Walk down bin row		W17P	255.0			
Turn toward location		TBC2	37.2			
Check Stock No. on document	2	EF	14.6			
Eyes to bin location		ET 6/16	5.6			
Check S/N on property in bin	2	EF	14.6			
Bend, stoop or kneel to the A, B, C, locations		B,S,KOK	29.0			
			17.2	R18B		Reach for unit/box in location
NOTE: this operation happens			2.0	G1A		Grasp unit/box
approx. 50% of the time.			17.0	M18B		Move from location
				~~G2~~		Regrasp unit to hold
Arise from bend, stoop or kneeling position		AB, AS AKOK	31.9			
NOTE: this operation happens			17.2	R18B		Reach for unit/box in location
approx. 50% of the time.			2.0	G1A		D, E, F, G locations
						Grasp unit box
			17.0	M18B		Move from location
				~~G2~~		Regrasp to hold
Turn away from location		TBC2	37.2			
Walk to cart/pallet from loc.		W17P	255.0			
Move item to cart/pallet		~~M~~				
Release		RL1	2.0			

No.	Element Description	Element Time TMU	.0006 Lev. T.	% Allow-ance	Element Time Allowed	Occur-rences per piece or Cycle	Total Time Allowed
1.	Walk to bin locations	375.0	.225				
2.	Walk down bin aisle to location	292.0	.175				
3.	Check S/N on material & documents	34.8	.021				
4.	Pull material from ABC location	97.1	.058	[illegible]			
5.	Pull material from DEF locations	36.2	.022				
6.	Carry units to cart/pallet	294.2	.177				
						TOTAL	

Obtain Flat Pallet or Safety Pallet NOTE: Add .209 to elements for obtaining forklift

DESCRIPTION	Occur distant	Time	
Accelerate		.0220	
Move to pallet			Moves with forklift, see page # Study 4
Turn		.0550	
Stop		.0150	
Run in first level		.0800	
Raise forks	6"	.0168	
Right and stop reverse		.0650	
		.2538	
Move to location			
Accelerate		.0220	
Move to location			Moves with fork lift in feet, see study #4
Turn		.0550	Down to this element is time for obtaining flat pallet
Turn and stop		.0700	which adds up to .2758 + f(.0023) = Time to obtain pallet
Accelerate		.0220	
Move down pallet row	40"	.1240	
Stop		.0150	
Raise pallet to location	72"	.2016	
		.5096	
Move safety pallet to outload			
Lower pallet	72"	.1296	
Accelerate		.0220	
Back out of pallet row	40"	.1240	
Turn and stop		.0800	
Accelerate		.0220	
Turn		.0550	
Stop		.0280	
		.4606	
	Total time for safety pallet = 1.4330 + f(.0023) = Time to obtain safety pallet		

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PAGE 2

OUT LOAD AREA--STORAGE FORKLIFT NOTE: Add .209 to elements below for obtaining forklift

Pick up pallet & move to truck	Occur. distant	Time		Moves with forklift (No. of ft. X .0023) Feet	
Move to pallet		.		5	.0115
Stop		.0600		10	.0230
Adjust forks	4"	.0120		25	.0575
Run in first level		.0800		50	.1150
Raise forks	4"	.0120		75	.1725
Tilt back		.0250		100	.2300
Back up, truck and stop		.0750		125	.2875
Accelerate		.0200		150	.3450
Move to truck		.		175	.4025
Stop		.0280		200	.4600
	Total	.3120	plus moves	225	.5175
				250	.5750
				275	.6320
Set pallet on truck				300	.6900
				325	.7475
Raise forks to truck bed level	10"	.0300		350	.8050
Run in first level		.0800		375	.8625
Lower forks	4"	.0072		400	.9200
Tilt forward		.0250		425	.9775
Run out first level		.0600		450	1.035
Turn and stop		.0650		475	1.093
	Total	.2672		500	1.115

AMC FORM 14 Nov 56 192G — GENERAL PURPOSE DATA SHEET (To be used as a worksheet or for copy preparation—not to be overprinted) — Previous Editions of this form may be used.

WORK MEASUREMENT PROJECT Repetitive Time Study Sheet		Page 1 of 1 Pages
Study No.	Operation Accomplish Kill Location in warehouses	Dept Code 595F64-65
Part Name & Type		Stock No. ----------
Location Warehouses 1D, IE, 1F, 16.	Machine No. ---------	Control Station No.
Operator's Name ------ / Operator's No. -------	Drawing No. -------	Observer F. Boldway
Material AF Form 227 / Weight --------	T.O. or Q.C.S. No. ----------	Date August 1958
Start Time	Stop Time	Elapsed Time

No.	Element Description	1	2	3	4	5	6	7	8	9	10	Tot / Cycle	Ave or Sel	Lev Fac	Nor T	Occ	Base Min
	Fill out AF Form 227	100	100	100	100	100	100	100	100	90	100						
	In one copy	.59	.72	.64	.83	.70	.69	.94	.61	.62	.70						
		100	100	100	100	100	100	100	100	100	100	1469					
		.63	.82	.84	.76	.80	.68	.71	.64	.72	.70	20	.739	100	.739	100	.739
	Prepare paper work,											721					
	Kill Location, in office			See page 2								20	.360	100	.360	100	.360
												409				1	
												4	1.02	100	1.02	18	.057
	Set aside documents	100	--	--	--	--	--	--	--	--	--	64					
	after location entry	.05	.07	.09	.08	.06	.07	.05	.07	.06	.04	10	.064	100	.064	100	.064

Remarks:	A. Total Time	
	B. PR & D Allowance	
	C. Task Allowance 25%	
Reviewed by (Date)	D. Standard Hours Per	
	Use	

MTM ELEMENT ANALYSIS

File

Part Name ______ Part No. ______
Oper. Name Prepare AF Form 50B Oper. No. ______
Operator ______ No. ______ Analyst T/Sgt. Cave Date 17 Dec 58

DESCRIPTION - LEFT HAND	F	MOTION	TMU	MOTION	F	DESCRIPTION - RIGHT HAND
Reach for tag 50B		R16B	15.8			
Grasp tag		G1B	3.5			
Move tag to work a rea		M16B	15.8	R16B		Reach for pen or pencil
Release tag		RL1	3.5	G1B		Grasp
Contact grasp to hold		G5	15.8	M16B		Move pen to write
				~~G2~~		Regrasp to write
			924.6	Write		Write (S/N, Class, Nomenclature)
						Quantity, Unit of Issue, Date
						30 Nos 22 Ltrs
Release tag		R12	17.0	M18B		Move pen aside
			2.0	RL1		Release

No.	Element Description	Element Time TMU	Convs. Factor .0006 Lev. T.	% Allow-ance	Element Time Allowed	Occur-rences per piece or Cycle	Total Time Allowed
1.	Get 50B tag	54.4	.0006		.0326	1	.0326
2.	Write information on 50B	924.6	.0006		.5547	1	.5547
3.	Pencil aside	19.0	.0006		.0114	1	.0114
						TOTAL	.5987

MTM ELEMENT ANALYSIS

File

Part Name ______ Part No. ______
Oper. Name Assy carton Oper. No. ______
Operator ______ No. ______ Analyst T/Sgt. Cave Date 30 July 59

DESCRIPTION - LEFT HAND	F	MOTION	TMU	MOTION	F	DESCRIPTION - RIGHT HAND
Reach for carton		R16B	15.8			
Grasp		G1A	2.0			
Move carton to desk		M16B	15.8	~~R12B~~		Reach to side of box
			2.0	G1A		Grasp
Apply pressure to sides of box	2	AP1	38.4	AP1	2	Apply pressure to sides of box
		~~G2~~		~~G2~~		Regrasp
Move box to table/bench		M8B	10.6	M8B		Move box to table
Release		RL1	2.0	RL1		Release
Reach to flap		R12B	12.9	R12B		Reach to flap
Grasp		G5	2.0	G5		Grasp
Apply pressure to close		AP2	10.6	AP2		Apply pressure to close
Regrasp		~~G2~~		~~G2~~		Regrasp
Move flap downward		M4B	6.9	M4B		Move flap downward
Reach w/finger to 3rd flap		R1B	2.0	R1B		Reach to 3rd flap
Move flap down		M4B	6.9	M4B		Move flap down
Regrasp to hold flaps		G2	5.6	~~RL1~~		Release
			10.1	R8B		Reach to 4th flap
			2.0	G1A		Grasp
Regrasp to hold flaps		~~G2~~	6.9	M4B		Move 4th flap down
			2.0	RL1		Release
			47.4	R16B	3	Reach to tape dispenser
			6.0	G1A	3	Grasp handle
			31.8	M8B	3	Pull handle forward
			31.8	M8B	3	Move handle back
			31.8	M8B	3	Pull handle forward
			6.0	RL1	3	Release
			25.8	R6B	3	Reach for tape
			6.0	G1A	3	Grasp tape
			47.4	R16B	3	Move tape to box
				~~G2~~		Regrasp
			63.0	P2NSE	3	Position tape on box

No.	Element Description	Element Time TMU	Convs. Factor .0006 Lev. T.	% Allow-ance	Element Time Allowed	Occur-rences per piece or Cycle	Total Time Allowed
1.	Assy carton	869.7	.0006		.522		
						TOTAL	

MTM ELEMENT ANALYSIS

File

Part Name ______ Part No. ______
Oper. Name Assy carton Oper. No. ______
Operator ______ No. ______ Analyst T/Sgt. Cave Date 30 July 59

DESCRIPTION - LEFT HAND	F	MOTION	TMU	MOTION	F	DESCRIPTION - RIGHT HAND
Regrasp tape		G2	16.8	G2	3	Regrasp
Move hand across tape to straighten	6	M12B	80.4			
Release	6	RL1	12.0			
Reach to tap of box and tape	6	R12B	77.4			
Grasp	6	G5	--			
			80.4	M12B	6	Move hand across tape
			12.0	RL1	6	Release
			77.4	R12B	6	Reach to top of box and tape
				G5	6	Regrasp
Move hand to side of box		M12B	13.4	M12B		Move hand to side of box
Regrasp		~~G2~~		~~G2~~		Regrasp
Move box to upright position		M12B	13.4	M12B		Move box to upright position
Turn hand to upright box		T180*	---	T180		Turn hand to upright box
Release		RL1	2.0	RL1		Release
Reach to flap		R16B	15.8	R16B		Reach to flap on box to open
Grasp		G1A	2.0	~~G5~~		Grasp
Move flap open		M8B	10.6	~~G2~~		Regrasp flap
			10.6	M8B		Move flap open
Release		RL1	2.0	RL1		Release

No.	Element Description	Element Time TMU	Convs. Factor .0006 Lev. T.	% Allow-ance	Element Time Allowed	Occur-rences per piece or Cycle	Total Time Allowed
						TOTAL	

SVENSKA MTM FÖRENINGEN
(Swedish MTM Association)

MTM 1959—AN INFORMATION CONFERENCE OF CURRENT INTEREST

Since MTM was introduced in Sweden in the early 1950's the interest for this technique has increased rapidly. More and more enterprises have brought this method into use in their industrial engineering program. To give information about current questions of MTM application, the Swedish MTM Association arranged a conference in Stockholm on May 28-29 this year. The conference assembled more than 300 participants, mainly production managers and industrial engineers from as well member enterprises as others.

On the first day a basic orientation about the MTM system was given to those participants who did not know the system earlier. The different basic motions were presented in an illustrative way together with a demonstration of the functioning of the system.

A report on the principles for development of methods and work places with MTM was the next item on the program. A good example on what can be done with the help of MTM when starting a new production was presented by Kongsberg Våpenfabrikk, Norway. This enterprise, which is a state owned factory for manufacturing of ordnance materials, etc., has also some civil products on their manufacturing program. Among other things they make different automobile parts for the Swedish automobile Volvo. One of these parts is the rear axle. When this production started they had no experience whatsoever in the making of automobile parts. In cooperation with industrial engineers from AB Volvo, Gothenburg, they started a line production and MTM was used for developing methods and work places. This production has been going on for more than a year now and the result is that the production time for the rear axle at Kongsberg Våpenfabrikk is about half of the time the former manufacturer used with the help of conventional work studies.

In another example was reported how MTM had been used for processing at AB Svenska Kullagerfabriken (SKF), Katrineholm, Sweden. It has often been said that MTM can be used only for production in large quantities, but SKF has with very good result been able to apply MTM in a job shop type production.

The first day of the conference ended with a report on a medico-physiological research allied to MTM, which has been made under the guidance of Dr. Nils Lundgren at the Industrial Physiological Department of the Gymnastical Central Institute, Stockholm. The research which involved certain working operations at SKF intended to give views on evaluation of work and to give propositions for bio-technological improvements. The operations in question represented different typical cases of physical load in the work. More research work will be done and it will be carried on by the Swedish MTM Association with the help of a newly employed research engineer.

The other day of this conference was dedicated to MTM for standard data and time formulas. After a report on the principles for their development followed different examples on applications.

In an interesting report the participants were informed about how AB Volvo Pentaverken had brought standard data into use for turret lathe work. This department of the enterprise has an ample assortment of lathes—12 different types are represented. In spite of the difficulties connected herewith, the data were developed in eight months—a comparatively short time. Today all methods and rate setting work for 24 turret lathe workers is handled by one man.

Another example on application of standard data and time formulas was given by AB Melka representing the ready-made clothing trade. This trade which has its special problems in connection with getting standard times has very good experiences of MTM.

Another subject that was dealt with was MTM as a basis for training and instruction. A direct use of an MTM analysis for such a basis is not advisable. By using the clarifying description which signifies an MTM analysis and then by simplifying and making additions to same, a training basis is obtained, which better meets with all requirements involved than many other forms of methods descriptions do.

"What representatives for Management and

Labor think about MTM" was the next item on the program, to which the participants had been looking forward with great interest. Representatives from the Swedish Employers' Confederation and also from one of the Federations of Trade Unions gave their views on this matter.

The spokesman for the Swedish Employers' Confederation stressed the importance for the Swedish industry of having at their disposal such an accurate measuring instrument which the different PTS systems represent. Without giving preference to any special method he accentuated the need that only one system would be used in the industry. In Sweden MTM is the only PTS system which has attained a wider spread.

The spokesman for the Federation of Trade Unions took a positive attitude towards MTM, even though, for obvious reasons, he was a little more critical because the experiences of MTM still are rather limited. The Federation will, however, not oppose the introduction of MTM. The Federation carries on its own training in MTM—its own experts are working with the purpose that the application of MTM shall fill all requirements expected. It is of the greatest importance that the enterprises wishing to use MTM really see to it that their industrial engineers obtain a thorough training in the technique and its application.

In one of the last addresses at the conference the procedure of introducing MTM at AB Bofors was described. When the MTM technique at the beginning was tried on a small scale the labor part was very reserved. However, since the firm through courses and information, to which also the trade union was invited to send representatives, had tried to widen the knowledge of MTM to all employed, the reserved attitude started to give away. When the time came for the first start of the system in practice a cooperative group was formed in which also representatives for the local trade union had members. The group took part of all plans and was in a position to discuss the establishing of work places etc. A very good cooperation was achieved. Today everything functions without any hitches or quarrels.

The conference ended by the chairman of the Swedish MTM Association, the managing director of AB Volvo Pentaverken, giving some views on the increased demands on cost reduction and raised efficiency within the industry. The increased competition involves higher requirements on our commercial and industrial life and the possibilities of using the resources of industry. Through the PTS systems coming into being, and among them MTM, today's industrial engineers have obtained entirely new possibilities in their efforts towards better products at lower costs.

This MTM conference was the first of its kind which the Swedish MTM Association has arranged. The addresses held can be considered to give a good picture of the situation as far as the application of MTM in Sweden is concerned. All addresses will be published in a special booklet.

The reaction on the part of the participants has during and after the conference been highly positive. The participants have been entirely unanimous in expressing that the conference has given a good picture of MTM and the possibilities created by this technique. There is no hesitation but that the conference has stimulated the interest for MTM. The additional flow of new members to the association is a good sign hereof. The aim of the association can be considered as achieved—to give information of MTM and its application as well as to give industry new impulses for including MTM in the industrial engineering program.

TRAINING OF MTM-INSTRUCTORS IN SWEDEN

The Swedish MTM Association has among other objectives the purpose of widening the knowledge of MTM in Swedish industry. For that reason the Association has, since it started in 1955, had a training committee to establish standards for MTM training and to work out necessary training programs, to develop exams and regulations thereof and to develop programs for the distribution of information about MTM.

The committee's most important task has been to form a basis of uniform training for MTM-technicians. This has been achieved partly by developing the training manuals, training programs, etc., and partly by taking care of the training of MTM-instructors.

These courses are primarily intended for qualified MTM-technicians who are to train other persons in MTM, and they lead to an exam which is equivalent to the American Association's "Qualified Practitioner." In cooperation with the American MTM Association the exams are developed and based upon those used in the United States. Those instructors who pass the exams will receive a certificate from the Swedish MTM Association giving them authority to examine

MTM-technicians in accordance with the standards of the Association.

Experience has also proved, that this sort of instructor training program is not only suitable but desirable for qualified MTM-technicians who are to supervise MTM application within the industry.

The curriculum includes a total of 84 hours of instruction over a period of two weeks, as follows:

Training methods	15 hours
Review of the Swedish MTM Association's training manual for MTM-instructors	44 "
Different kinds of MTM information programs	3 "
MTM-research	4 "
General questioning about MTM	4 "
The policy of the Association at an installation of MTM in a business enterprise and practical experience of MTM	4 "
Examination	10 "
	84 hours

For those attending the course complete training in MTM and evidence of passed examination are required. Furthermore, thorough practical experience of MTM application is needed and in order to judge the pupil's qualifications in this respect, they must turn in an evidence of proficiency, that is to say:

10 analyses from industrial work in different fields

1 example of methods engineering, e.g., analyses for estimating purposes and

1 time formula or standard data.

As the Swedish industry has had the experience that the use of MTM in a natural way has forced the methods engineers into the close related fields of physiology and safety, the Association has arranged 1-week courses in these subjects. These courses are intended as a supplementary training for MTM-instructors.

The first courses for MTM-instructors in Sweden were held in May 1957. At the end of 1957 twenty-eight instructors were trained and examined, and by the end of the following year the corresponding number was forty-eight. Today the total number examined MTM-instructors is seventy-four. Still another course will take place this fall and the estimated number of examined MTM-instructors at the end of this year will amount to about eighty-five.

Naturally the majority of these MTM-instructors are active within the Swedish industry, however, Norwegian and Finnish enterprises have also been represented at these courses.

FRENCH MTM ASSOCIATION

USE AND USERS OF MTM IN EUROPE

Summary of the Informations given at the MTM Conference of February 20, 1959, in PARIS, sponsored by Comité National de l'Organisation Française (C.N.O.F.).

Mr. Georges R. LAPOIRIE gave the following statistics:

1. Numbers of experts trained at the end of 1958:

France:	1.100	at least but only 463 have undergone an examination at the end of the course
Pays-Bas:	428	having passed successfully an examination
Suède:	1.500	

2. Number of experts using MTM:

Among people trained, some are not appointed to use MTM and attend a course only for information; some have been called at other charges in or outside the firm; some do not succeed in the job too.

So that the number of trainees do not give an exact idea of the users of MTM.

It was tried to get an opinion through a sample of 130 French firms having at least one employee trained in a course; the result was that the percentage of users among experts trained is probably higher than 40%.

3. Firms of consultants or organisms teaching MTM:

France:	10
Suède:	6
Pays-Bas:	3
Suisse:	1

4. Companies or public concerns using MTM:

France:	300
Pays-Bas:	90
Suède:	62
Suisse:	11

5. Types of industries:

See the list joined.

6. Fields in which MTM is used:

Here again, sampling was used to determine how frequently MTM is used in the different fields by firms having employees trained.

Methods improvement Work measurement	75%
Wages incentive	35%
Tools-design	25%
Operator's training	25%
Foremen training Estimating Developing Methods in advance	20%
Product design Selecting Effective equipments	5 à 10%

NATIONAL MTM ASSOCIATION NEWS II

(INDUSTRIAL MTM USAGE)

COMITE NATIONAL de l'ORGANISATION FRANÇAISE
57 rue de Babylone, PARIS (7e)

Réunion d'Information du 20 Février 1959 à PARIS
sur la Méthode MTM

Activités ou le MTM a été utilisé
(France, Pays-Bas, Suède, Suisse)

Culture
Mines de Houille
Laminage acier
Tubes acier
Grosse Forge
Fonderie
Tôlerie
Chauffage, Ventilation, Conditionnement
Matériel frigorifique
Machines outils
Tracteurs Agricoles
Machines Textiles
Mécanique précision
Fabrique d'Armes
Emboutissage, découpage
Décolletage
Estampage, Matriçage
Outillage à main
Emballage, conditionnement
Construction navale
Construction automobile
Accessoires automobiles
Construction Aéronautique et moteurs
Matériel électrique
Appareillage électrique
Fils électriques
Compteurs électriques
Matériels électro-domestiques
Piles et accumulateurs
Appareils radio-électriques
Matériel téléphonique
Matériel photographique
Horlogerie
Roulements à billes
Machines de bureaux
Verrerie
Céramique produits rouges
Céramique industrielle
Grès de batiment
Faïence
Porcelaine
Conditionnement produits pharmaceutiques
Pneumatiques et bandages caoutchouc
Articles caoutchouc
Amiante
Plastiques
Tabacs
Allumettes
Corps gras
Pâtes alimentaires
Biscuiterie et produits régime
Sucrerie
Vinaigrerie
Industries du lait
Champagne
Conserves
Chocolaterie
Textile lin et chanvre
Textile Jute, fibres diverses, ficellerie
Coten (filature, tissage, etc. ...)
Laine (peignage, filature, tissage, etc. ...)
Soie
Fibres artificielles
Bonneterie mécanique
Teinture, Apprêts
Confection chemises
Confection hommes
Lingerie
Ganterie
Maroquinerie
Peausserie
Cuirs industriels
Parquetterie
Meubles cuisine
Papiers
Façonnage papier
Imprimerie
Stylos
Transports
Services administratifs divers.

(FRENCH MTM ASSOCIATION)

MTM CONFERENCE, FEBRUARY 20, 1959, PARIS (France)

(L. to R.) M. PAGEZY, M. SOUMAGNAC, M. CAZALS.

February 20, last, the French MTM Association, sponsored by the Comite National de l'Organisation Française (C.N.O.F.) organized a conference to give informations upon the use of MTM in France and in Europe.

About sixty experts in MTM, in two groups, attended the morning session reserved to members of the Association only. The leader of the first group was Mr. PELISSOLO, Engineer "Comptoir des Textiles Artificiels"; the group discussed about the accuracy of MTM and the conclusion, tentatively was, that the degree of accuracy for non-repetitive and with long-cycle operations was not lower than for repetitive works with short cycles. The leader of the second group was Mr. LANGLOIS Engineer "La Société Anonyme des Fermiers Réunis"; the group discussed about the use of the so-called "second degree MTM data" and especially of the "Unified Standard data" Table, published by MAYNARD and Cy.

The afternoon session was open to everybody interested in MTM and about one hundred and fifty Engineers and technicians attended the meeting.

Mr. Max R. SOUMAGNAC as chairman of the French MTM Association, introduced the lecturers:

- Mr. Georges R. LAPOIRIE, Director "Les Ingénieurs Associés" (L.I.A.) gave some statistics on use and users of MTM in France and in Europe; it was pointed out that in some countries, in Sweden for instance, MTM seems to be taken into consideration by Union of workers in collective bargainings for calculating a fair day work.

- Mr. Maurice PAGEZY, Chief of the personnel Training Division—in the "Direction des Etudes et Fabrications d'Armement" (D.E.F.A.) explained very thoroughly the use of MTM inside his own department; he spoke of the training of experts and also pointed out how interesting is the "simplified data card" for improving foremen.

- Mr. Pierre COUDRAY, Engineer, Ste d'Orientation de Formation et d'Organisation Rationnelle (S.O.F.O.R.T.) described a case of application in the telephone apparatus industry which was to be illustrated afterwards by a movie made in the factory of ERICSON Cy.

- At length Mr. Albert KONTZLER, Cie Internationale des Machines Agricoles MacCORMICK, spoke of MTM applications in different plants of his company and especially of the very interesting results in foundry.

Then two films were exhibited:

The first "Work study and production control chronicle" was made by "Bureau des Temps Elémentaires" (B.T.E.) and the second, a color film, by SOFORT showed the "Assembling of a telephone-cap" at the ERICSON Cy.

Each of these two films, of which running time was about thirty minutes, explained very thoroughly what can be done with the MTM procedure in the fields of work simplification and of determining the most economical equipments.

Mr. Max SOUMAGNAC, as Chairman, closed the conference with the following conclusion:

"In fact, he said, the MTM procedure analyzing methods rather than operations can be used for any human and organized activity, even outside of the Industry, for repetitive operations with short cycles as well as for non-repetitive works. To summarize, what I wish to point out is the universality of the procedure, Of course anyone can study and use it alone and for his own needs and I wont even think to the danger for this lonely man to play the 'Apprentice to a sorcerer.'

But in the scientific modern world, working in group pays more; for, more and more every day, progress is measured by a good understanding of collectiveness in the field of Research."

(NIPPON MTM ASSOCIATION)

MTM PROGRESS IN JAPAN

by
James A. Gage
Chief Michigan Advisor to Waseda University

MTM has just celebrated its second birthday in Japan. Although no special program marked this event, the achievements of the Japan group are worthy of notice by the rest of the MTM world.

First MTM Contacts With Japan

The first MTM course was given to a group at Waseda University Institute for Productivity in August 1957. The instructors, James Gage and Richard Stoll, were sponsored by a University of Michigan-ICA-Waseda University productivity contract. Fourteen people completed the 105-hour course and received practitioners' certificates. Three Waseda professors, in residence at the University of Michigan, completed all requirements and were licensed as MTM instructors.

The U.S. Air Force also sent an MTM instructor to Japan in 1957. Fourteen Japanese employees at the Tokyo area bases received practitioners certificates.

The following year three MTM courses were given by U.S. licensed instructors. All examinations were issued and graded by the Ann Arbor MTM office. Forty-seven people passed the examination and received certificates.

Japan Forms An Independent Association

The first Japan MTM group was organized in 1957 as a chapter of the U.S. Association. The seventy-five practitioners licensed during the first year of operation came from the large population areas of Tokyo, Yokohama, Nagoya, and Osaka. Consulting firms quickly recognized the value of these MTM practitioners and employed many of the graduates from both the civilian and Air Force classes. Within one year MTM became a recognized part of the Japanese industrial vocabulary and the activity had become too big and vigorous to remain a chapter of the U.S. Association.

With the backing of top educators and industrialists, an independent national association was formed in October 1958. Recognition was requested as a Cooperating National Association (CNA) member. Favorable action on this request was taken by the Board of Directors of the U.S. Association on November 14, 1958. From this date the Japan MTM Association operated as an independent organization. Procedures were immediately set up to conduct training courses and to control the issuing of practitioners' licenses.

Organization of The Japan Association

The membership characteristics of the Japan Association are quite different from those of the U.S. Association. Primarily, most memberships are individual memberships. Any person licensed as a practitioner may become a member of the Japan Association. Interested educators and industrialists may also hold individual memberships. Consulting firms and industrial organizations hold company memberships. This latter type of membership is similar to the sustaining membership classification of the U.S. Association. There are no professional memberships comparable to those of the U.S. Association. At present there are 136 individual memberships and 15 company memberships.

General policy is set by a board of directors selected from the individual membership group. Day to day activities are controlled by a three-man executive committee. It is of interest to note that two members of the executive committee received their instructor's licenses in the United States. This executive committee plus an office manager have about the same combined duties as the executive secretary of the U.S. Association. The office manager is the only full-time paid employee of the Japan Association.

Translation Difficulties

Because of the extreme differences between the English and Japanese language, exact translations of MTM literature are very difficult. Words such as REACH, TURN, MOVE, etc., having a specialized MTM meaning, are incapable

of proper translation into Japanese. Attempting to mix these Roman letter MTM words with Japanese kanji (characters) imposes still further problems.

A workable solution has been to teach MTM partly in English and partly in Japanese. Most educated Japanese people can read English fairly well even though they may speak it with difficulty. Part of the reading material for MTM classes is presented in English. The verbal explanation is given in Japanese interspersed with English.

The text "Engineered Work Measurement" by Karger and Bayha is in the process of being translated. The earlier Maynard-Stegemerten-Schwab text is already available in Japanese. It is the opinion of this writer that neither of the above translations can give a completely clear version without supplementary reading of the English language editions.

Final examinations are presented in dual language form. Each test sheet is printed in two columns. The left-hand column gives the questions in English. The right-hand column presents the identical questions in Japanese. These tests are longer and more comprehensive than the U.S. versions. The eight percent failure rate produced by these tests indicates the high attainment level required by the Japan Association. All tests are issued and graded by the Association. Tests are in the custody of the Association office manager and he is always physically present when tests are given. Each test set is numbered and strict accountability is maintained.

To date all instructors have been licensed by the U.S. Association. Work has now begun on preparing an instructor licensing procedure based on U.S. practices. 122 people have so far passed either the U.S. or the Japanese practitioners' exam. With an increase in instructors, the training and licensing of practitioners should proceed at an accelerated rate.

Other Association Activities

Besides testing and licensing activities, the Japan Association carries on an extensive educational program. Appreciation courses have been given in various cities throughout Japan. An excellent journal is published quarterly. The data card has recently been converted to the metric system. Some research has been done on walking data. The average Japanese workman is much smaller than the U.S. workman and the length of pace data is now being investigated.

The Japan group is fortunate that it has not had to suffer the financial growing pains that characterized the first years of the U.S. Association. Since the beginning the Japan Association has operated in the black. The quality and enthusiasm of its membership has created a good industry acceptance of MTM installations. Quoting from a recent statement of Association plans for the coming year—"We shall do our best to bring about wider use of MTM in Japan—We must always stand ready to provide prompt MTM assistance to any organization requesting it."

EFFECTIVE MARCH 1, 1959 ORDER BLANK

RESEARCH REPORTS	QUANTITY	UNIT PRICE Member, Academic, Library	UNIT PRICE Non-Member	EXTENSIONS
R.R. 101		$ .75	$10.00	
R.R. 102		.50	10.00	
R.R. 104		.50	10.00	
R.R. 105		2.25	15.00	
R.R. 106		2.25	15.00	
R.R. 107		2.25	15.00	
R.R. 108		2.25	15.00	
R.R. 109		2.50	15.00	
R.R. 110		2.50	15.00	
Application Training Supplement		2.00	2.00	
Conference Proceedings				
1954, 1955, 1956 MTM Conference		3.00	3.00	
1957 MTM Conference		5.00	7.50	
1958 MTM Conference		5.00	7.50	
Data Cards				
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RESEARCH REPORTS

R.R. 101 Disengage

This report contains a preliminary study of the element disengage. While it is still classified as tentative, the report contains some extremely interesting conclusions on the nature and theory of this element.

R.R. 102 Reading Operations

The first step in the use of MTM for establishing reading time standards is contained in this report. In addition, the report contains a synopsis of the work done in this field by 11 leading authorities.

R.R. 104 MTM Analysis of Performance Rating Systems

A talk presented at the SAM-ASME Time and Motion Study Conference, April 1952. It contains an analysis of performance rating systems and various performance Rating Films from an MTM standpoint.

R.R. 105 Simultaneous Motions

This report represents almost two man-year's work on a study of Simultaneous Motions. It is a final report of the Simultaneous Motions project undertaken by the MTM Association. While it does not purport to provide complete and exhaustive answers to all problems in the field of Simultaneous Motions, it presents a great deal of new and valuable information which should be of interest to every MTM practitioner.

R.R. 106 Short Reaches and Moves

This report contains an analysis of the characteristics of Reaches and Moves at very short distances. It develops important conclusions concerning the application of MTM to operations involving these short distance elements.

R.R. 107 A Research Methods Manual

The research activity of the Association has developed an effective and comprehensive set of methods for carrying on research in human motions. This report details the major techniques used. Adequate sources of motion data, film analysis, data recording, and statistical methods of analysis are among the topics discussed.

R.R. 108 A Study of Arm Movements Involving Weight

In this report, the results of a large investigation into the effect of weight on the performance times of arm movements are presented. While more effective means of determining correct time allowances for moving weights are given, the comprehensive discussion of the whole area of weight phenomena is probably of more fundamental importance. The effect of such conditions of performance as the use of one or two hands, sliding vs. spatial movements, and male and female performance are among the topics presented.

R.R. 109 A Study of Positioning Movements

I. The General Characteristics. II. Appendix.
This report, the first of two position reports, defines "positioning movements and the interrelation of component movements." The study is limited to the laboratory analysis, and contains an appendix dealing with several subjects outside the major objectives.

R.R. 110 A Study of Positioning Movements

III. Application to Industrial Work Measurement.
This report, the second on position, relates the results of the position research to the field of application. This study deals with actual industrial operators and work measurement tools, and the evolution of an improved and more efficient technique for controlling and improving manual activity through better understanding of positioning movements.

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